RESOURCE TRACKING PATTERNS IN ACARI ASSOCIATED WITH BIRDS IN HAWAII VOLCANOES NATIONAL PARK: A PRELIMINARY REPORT*

M. Lee Goff
Department of Entomology
Bernice Pauahi Bishop Museum
Honolulu, Hawaii 96818

For some time now, host-parasite relationships have been an area of important and frequently controversial inquiry among systematists. Studies of Mallophaga infesting birds by Clay (1949, 1950, 1957); the streblid batflies by Wenzel et al. (1966); and the Macronyssidae and Laelapidae of bats by Radovsky (1967, 1969) have provided examples which have led to the somewhat optimistic statement: "parasite phylogeny paralleles host phylogeny" (Kethley & Johnston 1975). In more rigorous terms this may also be expressed: "parasite inter-relationships are congruent with host inter-relationships" (Kethley & Johnston 1975). Recently Acari infesting birds have been studied with some emphasis given to host-parasite co-evolution (Kethley 1971). These Acari may be divided into three groups based on their interaction with the bird host (Fig. 1). Group I contains the host-dwelling mites. Here, most or all of the life cycle of the mite is spent on the host. Group II contains the nest-dwelling ectoparasites. These mites visit the host only to feed and spend the remainder of their life cycle in the nest. Group III mites are the field parasites. These mites, most notably the chiggers and ticks, are associated with the host only for feeding. Wide host ranges are typically associated with Group III mites.

Group I parasites have been the primary source of data for the construction of patterns of radiation, as shown in Figure 2 for the Acaridei, and for tentative phylogenies, as shown in Figure 3 for the parasitic Gamasina (after Radovsky 1969). It is of interest that in the Acaridei (Fig. 2) there is an actual difference in the life cycle corresponding to the difference in habitat, as the deutonymphal stage, or hypopus, is absent from parasitic forms. A tendency toward reduction in stages in the life cycle, or tachygenesis, is common among parasitic forms. The house dust mites (family Pyroglyphidae) are placed in an intermediate position between the nest habitat and the parasitic habitat in Figure 2. This results from the belief that these

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* Studies upon which this report is based were supported in part by Cooperative National Park Resources Studies Unit Contract CX 8000-7-0009 to the University of Hawaii and in part by National Institutes of Health Grant AI 13893 to Bishop Museum.

mites are parasitic forms which have secondarily reverted to the nest habitat (Wharton 1976). In both Figures 2 and 3, the nest habitat is shown to be an intermediate step toward parasitism. The nest serves as a stable food source for nidicolous mites as well as a concentrating mechanism for their mating. In many instances, this association has been shown to be a forerunner of parasitism, for example, in the parasitic Gamasina (Radovsky 1969). It is also of some interest to note that the bird-infesting Rhinonyssidae are believed derived from the bat-infesting Macronyssidae (Fig. 3). In this instance, strict adherence to the previously stated concept of host-parasite congruence would require that one derive the birds from the bats. With relative safety, I feel that I can say this is slightly unreasonable. In the past such non-congruencies have been explained by invoking either the "accidental transfer" or "historical accident," which imply some form of selection error on the part of the parasite.

The possibility that something other than an accidental transfer was operating was suggested by Kethley and Johnston (1975), based on studies of quill mites of the family Syringophilidae (Kethley 1971). They observed that the mites had not tracked their hosts as a unit through their evolution, but instead, topographic sub-units of the host. In the case of the Syringophilidae the parameters of quill diameter and wall thickness were the major determining factors in the mite population. Thus distantly related, or in some instances apparently non-related, hosts which had structurally similar feathers were observed to support closely related mite populations.

With this background, it might be expected that similar patterns would be found in mites infesting the external portions of feathers. The feather mites of the superfamily Analgoidea comprise a complex of over 50 families. These are highly derived mites with varying degrees of host specificity (Krantz 1971). Feather mites are primarily grazers on the surface of the feather and do not normally appear to cause any injury to the host, thus large numbers of mites per host are common. Members of the family Analgidae are frequently noted from a wide range of hosts (Krantz 1971), but generally from hosts with similar feathers. Among species of Proctophyllodidae, most notably the genus <u>Proctophyllodes</u>, a high degree of host specificity is noted, with 38% of the species reported from a single host species (Atyeo & Braasch 1966). Thus in the feather mites, there are indications that both co-evolution and resource tracking are present. Due to the relative isolation of the Hawaiian Islands, and the number of endemic birds present, Hawaii Volcanoes National Park presents an ideal situation for the study of these patterns in the birds. At present both endemic and introduced birds are being collected and processed for ectoparasites in conjunction with a study of avian malaria, sponsored by the Cooperative National Park Resources Studies Unit (CPSU).

Identifications completed to date are presented in Tables 1 and 2. While conclusions cannot be drawn at this time, several undescribed taxa have been encountered and new records for hosts and localities are present in the data. Prior to this study only the families Analgesidae and Proctophyllodidae had been reported from the Hawaiian Islands (Garrett & Haramoto 1967). In the Proctophyllodidae, only the genus *Proctophyllodes* was reported. All other feather mite records are new. The recovery of specimens of cytoditids from the Red-billed Leiothrix constitutes a new host record. The recovery of *Neharpyrhynchus* sp. from an 'Amakihi constitutes both a new host record and the first record of this genus from Hawai'i.

Following completion of taxonomic studies, host-parasite relationships will be studied to determine which patterns are present in the feather mites associated with endemic birds and these results compared to currently available taxonomic structures for the species involved.

ACKNOWLEDGEMENTS

I am indebted to Dr. Warren T. Atyeo, University of Georgia, for providing identifications of feather mites. Harpyrhynchidae were identified by Dr. Wayne W. Moss, Philadelphia Academy of Sciences. Birds were collected and processed under the direction of Dr. Charles van Riper III.

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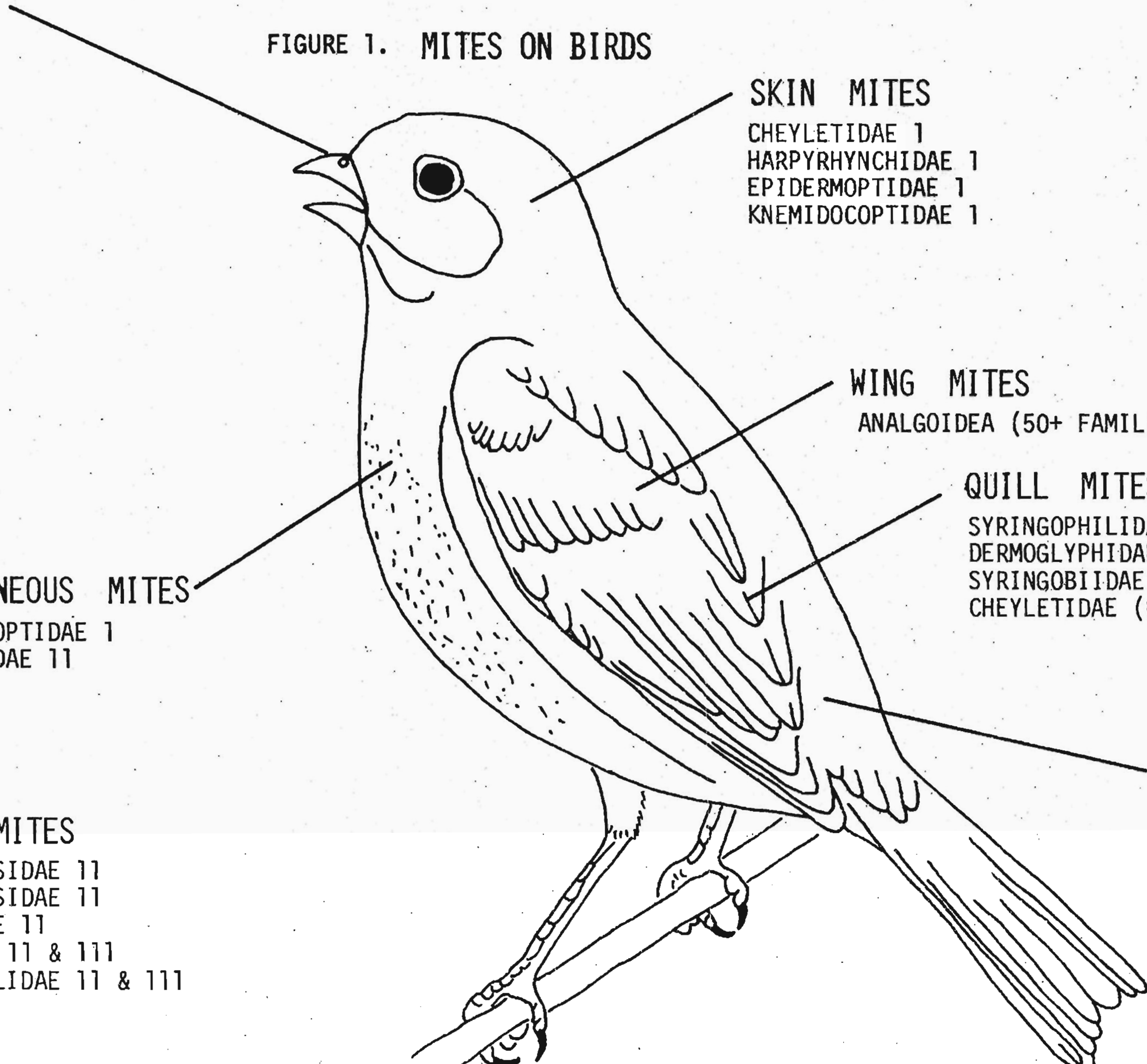
TABLE 1. Mites recovered from body washes of birds.

Bird	Mites Recovered Family	Genus & Species
'Amakihi (<u>Loxops virens</u>)	Rhinonyssidae Harpyrhynchidae	<u>Ptilonyssus</u> sp. <u>Neharpyrhynchus</u> sp.
'Apapane (<u>Himatione sanguinea</u>)	Laelapidae Rhinonyssidae	<u>Androlaelaps</u> sp. <u>Ptilonyssus</u> sp.
'Ōma'o (<u>Phaeornis obscurus</u>)	Rhinonyssidae	<u>Ptilonyssus</u> sp.
Red-billed Leiothrix (<u>Leiothrix lutea</u>)	Cytoditidae	<u>Cytodites</u> sp.
Japanese White-eye (<u>Zosterops japonicus</u>)	Cheyletidae	<u>Neocheyletiella</u> sp.

TABLE 2. Feather mites recovered from endemic and introduced Hawaiian birds.

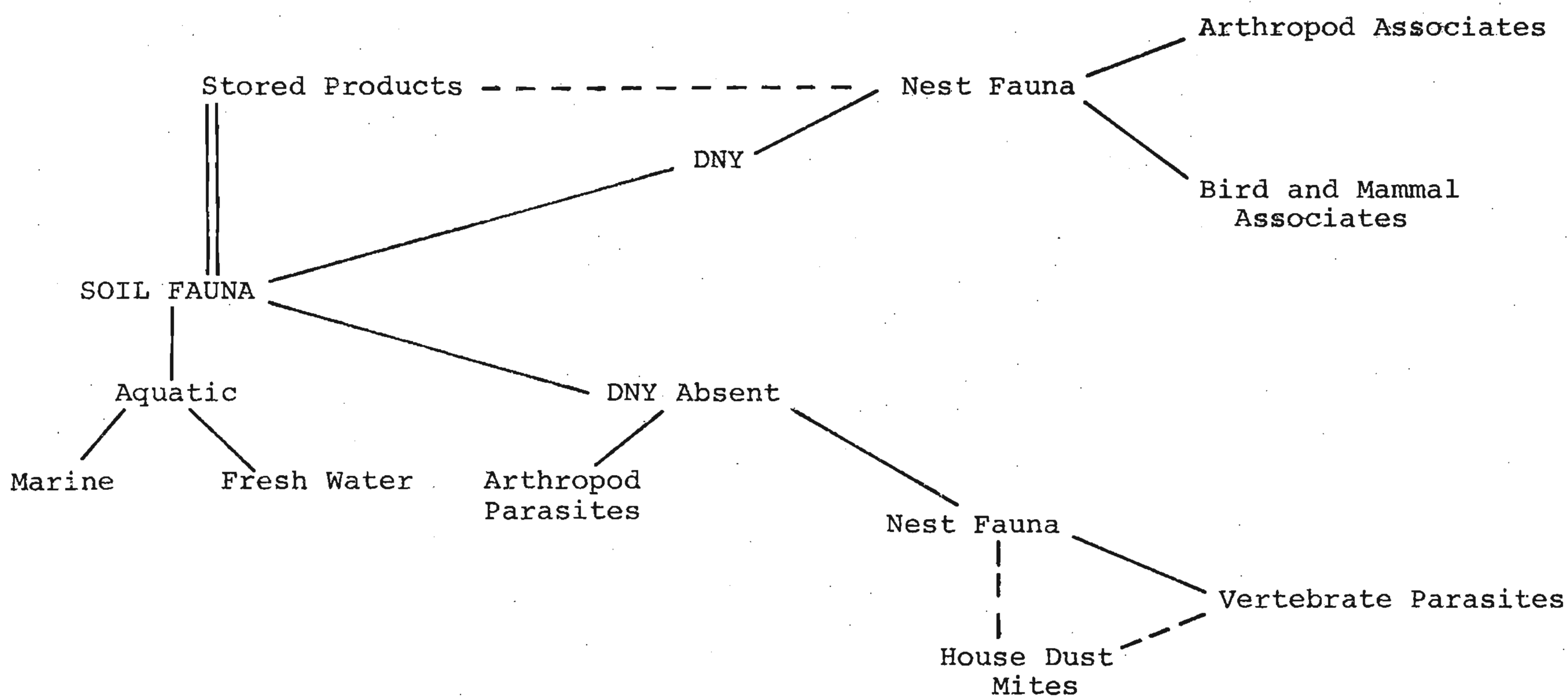
Bird	Mite Family	Mite Genus & Species
'Amakihi (*Loxops virens*)	Analgidae	*Analges* sp.
	Proctophyllodidae	*Proctophyllodes* sp.
		Pterodectes sp.
	Trouessartiidae	*Trouessartia* sp.
	Xolalgidae	n. gen. & n. sp.
'Apapane (*Himatione sanguinea*)	Analgidae	*Analges* sp.
	Proctophyllodidae	*Proctophyllodes* sp.
		Pterodectes sp.
House Finch (*Carpodacus mexicanus*)	Proctophyllodidae	*Proctophyllodes pinnatus*
House Sparrow (*Passer domesticus*)	Proctophyllodidae	*Proctophyllodes troncatus*
'I'iwi (*Vestiaria coccinea*)	Analgidae	*Analges* sp.
	Proctophyllodidae	*Proctophyllodes* sp.
Laysan Finch (*Psittirostra cantans*)	Analgidae	*Analges* sp.
Red-billed Leiothrix (*Leiothrix lutea*)	Pteronyssidae	n. gen. & n. sp.
'Ōma'o (*Phaeornis obscurus*)	Analgidae	*Analges* sp.
	Proctophyllodidae	*Proctophyllodes* sp.
	Trouessartiidae	*Trouessartia* sp.
Pueo (*Asio flammeus*)	Xolalgidae	n. gen. & n. sp.
Rice Bird (*Lonchura punctulata*)	Analgidae	*Onychalges* sp.
Japanese White-eye (*Zosterops japonicus*)	Analgidae	*Anhemialges* sp.
		Strelkoviarus sp.
	Pteronyssidae	*Mouchetia dolichosikya*
	Trouessartidae	*Calcealges yunkeri*
		Trouessartia sp.

FIGURE 1. MITES ON BIRDS



1 HOST DWELLING
11 NEST DWELLING
111 FIELD PARASITES

FIGURE 2. Proposed radiation of the Acaridei.



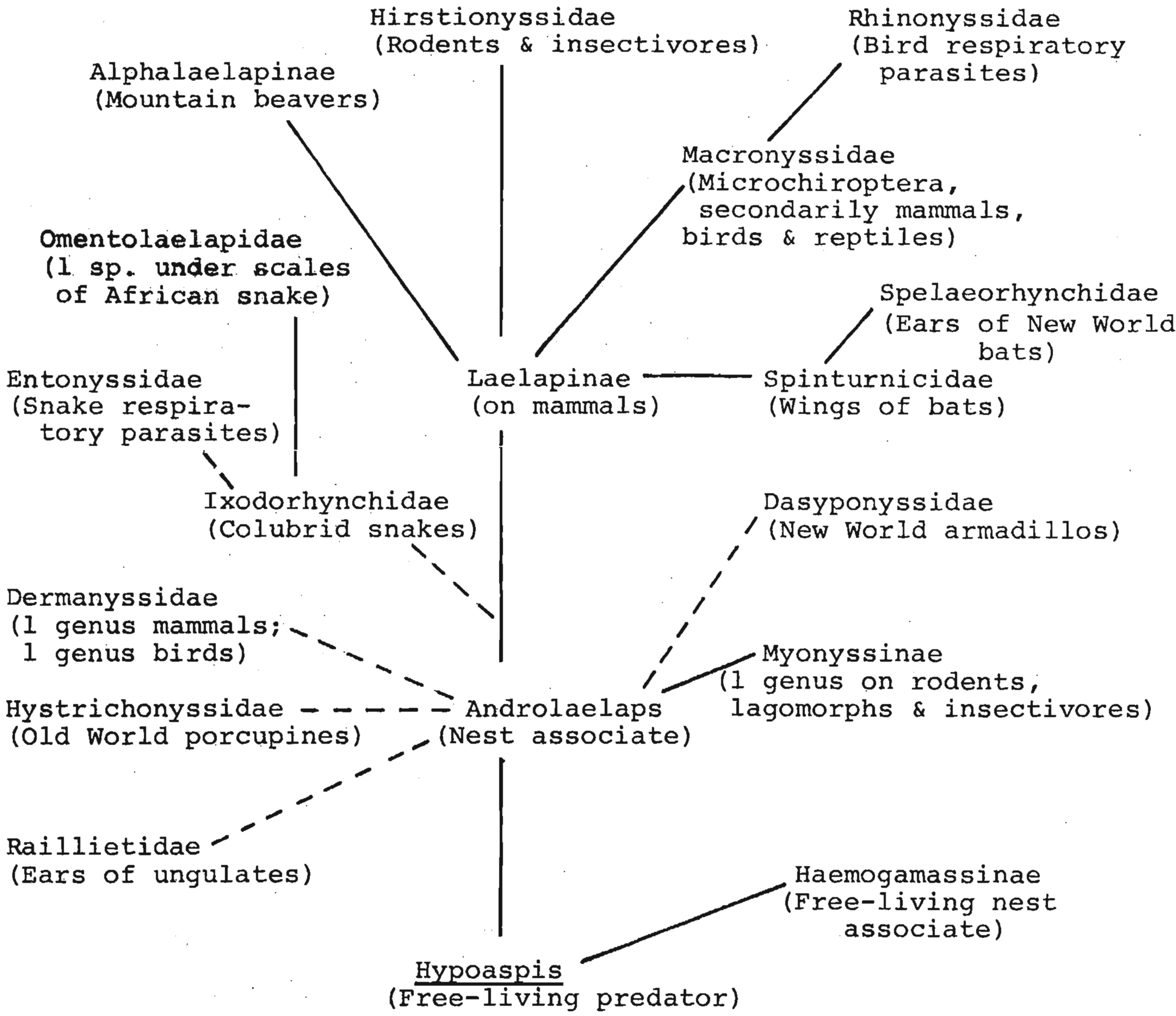


FIGURE 3. Adaptive radiation in the parasitic Gamasina (after Radovsky 1969).